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OF
CIVIL ENGINEERS



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BOSTON SOCIETY OF CIVIL ENGINEERSFOUNDED 1848

PROCEEDINGS

PAPERS IN THIS NUMBER.

"Rat Extermination and Proofing with Relation to Prevention of Plague." By L. L. Williams.

Memoir of deceased member.

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Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF MEETINGS.

BOSTON, January 26, 1921. — A regular meeting of the Boston Society of Civil Engineers was held this evening at Chipman Hall, Tremont Temple, and was called to order at 7.50 o'clock by the President, Frank A. Barbour.

There were present 120 members and visitors.

By vote the reading of the record of the last meeting was dispensed with.

The Secretary reported for the Board of Government the election to membership of the following candidates in the grades named:

Members — Messrs. William H. Chase, Theodore P. Clark, Walter L. Cronin, Francis A. Garvin, Parker Holbrook, Anselmo Krigger, Charles A. Leary, Franklin E. Leland, Francis R. Mac-

Leay, George H. Newcomb, J. Francis Travers, Jr., David J. White, Walter A. Woods and Frank V. Wright.

Juniors — Messrs. James F. Harvey, Scott Keith and Albert G. Martin.

The Secretary also reported for the Board its recommendation that the following vote be passed:

Voted: That the entire income of the Permanent Fund for the current year be appropriated and placed at the disposal of the Board of Government for use in payment of the current expenses of the Society.

On motion duly made and seconded, the above vote was passed unanimously.

The Secretary read the following reports:

REPORT OF JOINT COMMITTEE ON LICENSING ENGINEERS.

To the Members of the

BOSTON SOCIETY OF CIVIL ENGINEERS, BOARD OF GOVERNMENT; BOSTON SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS; BOSTON SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS; BOSTON SOCIETY OF ARCHITECTS; BOSTON CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS; BOSTON SECTION, AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS; BOSTON SECTION, AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS; BOSTON SOCIETY OF LANDSCAPE ARCHITECTS:

Gentlemen, — The Committee of the Boston Society of Civil Engineers appointed to consider the matter of the licensing of engineers, being of the opinion that a statute providing for the registration of professional engineers should also cover all branches of the professions of engineering and architecture, recommended that its membership should be enlarged to include one representative each from other engineering and architectural societies.

The President of the Boston Society of Civil Engineers, on request of this committee and with the authorization of the Board of Government, invited representatives from such other professional organizations to join with the committee of the Boston Society of Civil Engineers, and representatives were appointed by the following societies:

Boston Section, American Institute of Electrical Engineers.
 Boston Section, American Society of Mechanical Engineers.
 Boston Society of Architects.
 Boston Chapter, American Association of Engineers.
 Boston Section, American Society of Heating and Ventilating Engineers.

Boston Section, American Institute of Mining and Metallurgical Engineers.

Boston Society of Landscape Architects.

The committee of the Boston Society of Civil Engineers and the representatives of the above-named societies voted to form and act as a joint committee. The chairman was requested to prepare a draft of a proposed law for the registration of architects and engineers by the Commonwealth, it being voted not to include land surveyors. Subcommittees were requested to prepare arguments in favor of and against such registration. This work was done, a tentative bill and the arguments pro and con being submitted to all the members of the committee.

On January 4, 1921, a bill was filed in the legislature by the Boston Chapter, American Association of Engineers, to regulate the practice of the profession of engineering and land surveying.

At a meeting of the joint committee held on January 7, 1921, it was voted:

1. That legislation relative to the registration of architects and engineers by this year's session of the legislature should not be recommended.
2. That the Boston Chapter, American Association of Engineers, be requested to withdraw, for this year, its bill filed with the legislature to regulate the practice of the profession of engineering and land surveying.

Respectfully submitted as a report of progress.

(Signed)

CHARLES W. SHERMAN,
CHARLES M. SPOFFORD,
CHAS. R. GOW,

CHARLES T. MAIN,
I. E. MOULTROP,
EDWIN H. ROGERS, *Chairman*,

Representing BOSTON SOCIETY OF CIVIL ENGINEERS.

L. W. ABBOTT,
Representing BOSTON SECTION, AMERICAN
INSTITUTE OF ELECTRICAL ENGINEERS.

A. L. WILLISTON,
Representing BOSTON SECTION, AMERICAN
SOCIETY OF MECHANICAL ENGINEERS.

C. H. BLACKALL,
Representing BOSTON SOCIETY OF ARCHITECTS.

ALLEN HUBBARD,
Representing BOSTON SECTION, AMERICAN
SOCIETY HEATING & VENTILATING ENGINEERS.

GEO. A. PACKARD,
Representing BOSTON SECTION, AMERICAN
INST. MINING & METALLURGICAL ENGINEERS.

BREMER W. POND,
Representing BOSTON SOCIETY OF LANDSCAPE ARCHITECTS.

JANUARY 19, 1921.

TO BOSTON SOCIETY OF CIVIL ENGINEERS:

The undersigned, representative of Boston Chapter, American Association of Engineers, invited on your Committee for the Registration Bill, takes the liberty to submit a minority report recommending:

To support the Engineers' Registration Bill already entered by Boston Chapter, American Association of Engineers, for the following reasons:

1. The urgent need of registration of engineers does not warrant postponing the bill until next year, and the last day for entering bills for this legislature is passed.

2. Boston Chapter, American Association of Engineers, has been working on the bill for over a year, has studied those of other states and the working of same, and has employed competent legal advice on the draft of the bill.

Respectfully submitted,

(Signed) HARRY SHARPE,

Chairman, Legislative Committee,

Boston Chapter, American Association of Engineers.

By vote, the reports were accepted and placed on file.

Professor Spofford submitted the following motion, which was duly seconded:

"That it is the sense of this meeting that in view of the importance of having uniformity of registration laws in all states, and the fact that such laws have in some states proven to be inoperative and are now in process of amendment, the Committee on Registration of this Society be authorized to represent the Society before the Legislature in favor of having the bill for Registration of Engineers and Surveyors now before the Legislature referred to the next General Court."

After a discussion in which Professor Spofford and Messrs. Metcalf, Monaghan, Rogers and Guppy of the Society, and Dr. Frederick H. Newell, a past president of the American Association of Engineers, took part, the motion was lost.

The hour for the literary exercises having arrived, the President introduced Mr. Roderick B. Young, senior assistant laboratory engineer, in charge of engineering materials and chemical division of the Hydro-Electric Power Commission of Ontario, who read a paper entitled, "New Methods of Proportioning Concrete in Theory and Practice." The paper was illustrated with numerous slides.

At the conclusion of the reading of the paper, Capt. L. N.

Edwards contributed a short but most interesting discussion on the subject of the paper.

On motion of Prof. L. J. Johnson, the thanks of the Society were voted to Mr. Young and Captain Edwards, for their interesting contributions.

The President submitted for the Board of Government its recommendation that the Society join the Federated American Engineering Societies. The President stated that the Board had carefully considered the cost involved in such action and had come to the conclusion that the additional expense could be met without increasing the dues or curtailing the present activities of the Society. One method which had been suggested was that there be sent out, with the bill for dues for the coming year, an invitation to members interested in this action by the Society, to contribute a small sum, not exceeding two or three dollars each, towards the dues for membership in the Federation.

Colonel Gunby moved, and it was duly seconded, That it is the sense of this meeting that the Boston Society of Civil Engineers should join the Federated American Engineering Societies and that this matter be referred to the membership by letter ballot. On a vote being taken the motion was carried.

The Secretary announced that a canvass by the Board of Government of the letter ballot on the adoption of the "Resolutions concerning a proposed amendment of the Federal Water-Power Act" printed in the January JOURNAL of the Society under the Minutes of the December, 1920, meeting, showed the following result: 297 voted yes, and 10 voted no.

The President announced the death of Edmund M. Blake, a member of the Society, which occurred on January 12, 1921. The President has named the following committee to prepare a memoir of Mr. Blake: Messrs. Henry A. Symonds and L. Leroy Hammond.

The Secretary presented a memoir of William M. Brown, a member of the Society, who died May 28, 1920, prepared by a committee consisting of Messrs. Howard A. Carson and Henry T. Stiff, and by vote it was accepted and ordered printed in the JOURNAL.

At 10.10 o'clock the Society adjourned.

S. E. TINKHAM, *Secretary*.

BOSTON, MASS., January 5, 1921. — A regular meeting of the Sanitary Section of the Boston Society of Civil Engineers was held this evening in the Society Rooms, Tremont Temple. The meeting was called to order at 7.40 P.M. by Chairman Edward Wright.

The records of the December meeting were read and approved.

Copies of the reports of the Special Plumbing Board of the Massachusetts Department of Public Health, on "The Advisability of Standardizing Municipal Regulations Relating to Plumbing and Drainage," were distributed.

This report was discussed by Prof. George C. Whipple, of the Department of Public Health; Edward C. Kelly, of the Massachusetts State Association of Master Plumbers; Dana Somes, of the Boston Society of Architects; Bertram Brewer and Erastus Worthington.

On motion of Mr. Wentworth it was *voted*: "That a committee of three be appointed by the Chairman to study the report of the Special Plumbing Board and to aid in securing legislation to revise the plumbing rules."

The Chairman then introduced Dr. L. L. Williams, past assistant surgeon, U. S. Public Health Service, who spoke on "Rat Extermination and Proofing in Its Relation to the Prevention of Plague."

Dr. Williams described his experiences in rat-proofing and extermination at New Orleans and other cities.

The subject was discussed by Mr. H. C. Mosman, of the Massachusetts Department of Health.

On motion of Mr. Marston, a rising vote of thanks was given Dr. Williams, Mr. Mosman, Mr. Kelly and Mr. Somes, for their courtesy in speaking to the Society.

Adjourned at 10.00 P.M.

Members present, 30.

JOHN P. WENTWORTH, *Clerk*.

BOSTON, December 8, 1920. — A regular meeting of the Designers Section of the Boston Society of Civil Engineers was called to order at 6.10 this evening, by Chairman Ralph W.

Horne. After the minutes of the previous meeting were read and approved, Mr. George A. Sherron was introduced, and addressed the Section upon the subject, "Modern Concrete Road Construction; Machinery and Methods."

His instructive talk was well illustrated by lantern slides and three reels of motion pictures.

The meeting adjourned at 8.25 P.M.

Respectfully submitted,

A. L. SHAW, *Clerk.*

JANUARY 12, 1921. — The regular January meeting of the Designers Section was called to order at 6.10, Chairman Horne presiding. The reading of the minutes of the last meeting was omitted on account of the absence of the Clerk. There were 33 present.

Mr. J. G. Rae, of the Turner Construction Company, spoke upon the subject of "Practical Design from the Contractor's Point of View," pointing out common difficulties in construction and bringing many valuable suggestions before the meeting. Mr. Percy Mosher, of the Boston Transit Commission, opened the discussion, presenting several new thoughts; and a very lively discussion followed.

After extending to the speaker a rising vote of thanks, the meeting adjourned at 7.30 P.M.

A. L. SHAW, *Clerk.*

APPLICATIONS FOR MEMBERSHIP.

[February 15, 1921.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which

will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

BOYD, WALTER EUGENE, Hudson, Mass. (Age 30, b. Cochrasset, Mass.) From 1910-12 studied civil engineering at Brown University; 1912-13, worked with Erwin O. Hathaway, city engineer of Nashua, N. H., as chainman, rodman, etc., on municipal and private surveys; 1913-16, on the Panama Canal, doing field and office work on hydrographic and topographic surveys, supervising dredging with the Dredging Division; 1916-17, with the building department of the General Electric Co.; 1917-18, was first lieutenant in 102d Infantry; 1919 to date, with the General Electric Co., on building estimates and computations. Refers to W. M. Bailey, E. O. Hathaway, W. D. Morrill and F. J. McCann.

CONNOR, BERNARD DOMINIC, Somerville, Mass. (Age 25, b. Proctor, Vt.) Graduated from Somerville High School in 1913, and from Tufts Engineering School in 1917. Previous to graduation, in 1915, spent three months as rodman, levelman and draftsman in mining survey in Virginia; 1916, three months as engineer and inspector on electric conduit construction in Charlestown, and two months during college year as draftsman on conduits, etc., with the Charlestown Gas & Electric Co.; in 1917 had five months with the N. Y., N. H. & H. R. R., as rodman on construction of railroad yard facilities, etc.; and two months with the Aberthaw Construction Co.; 1918-19, was in the Engineers Regiment for eighteen months; 1919-20, with the City Engineer of Lynn; 1920-21, with the J. G. White Engineering Corp. on a water-power survey in the Adirondacks, as chief of party on stadia survey. Refers to M. H. Mellish, J. W. Raymond, Jr., E. H. Rockwell, F. B. Sanborn, A. S. Tuttle, W. L. Vennard and J. P. Wentworth.

FLYNN, FRANCIS G., Dorchester, Mass. (Age 23, b. Roxbury, Mass.) Graduate of Boston English High School in 1916, of Lowell Institute in 1917, and a student in civil engineering at Northeastern College 1917-18. Worked as chainman in the Public Works Department, Boston, during the summers of 1912-13; draftsman, inspector and estimator with the Boston Wharf Co., 1915-19; rodman and inspector with the B. & M. R. R., 1920-21. Refers to S. P. Coffin, P. Jones, J. J. Rourke and W. A. Woods.

HORGAN, JEREMIAH J., Fitchburg, Mass. (Age 30, b. Fitchburg, Mass.) Took civil engineering course with the International Correspondence School, 1910-16, nearly completed; 1920-21, Mass. University Extension course in elements of structures, about half completed; 1910-15, was rodman and

transitman with Pratt & Davis, Fitchburg, Mass.; 1915-17, was transitman with the City of Fitchburg; 1917-19, was chief of party with Parker, Bateman & Chase, Fitchburg; 1919 to date, chief of field party in construction, Boston & Albany R. R., South Station. Refers to F. W. Bateman, J. G. Brackett, G. H. Chase, A. Curtis and E. E. Lothrop.

MACAULEY, RALPH FAIRFIELD, Cambridge, Mass. (Age 22, b. Boston, Mass.) Graduate of Mechanic Arts High School in 1917; took a course in civil engineering at Tufts in summer of 1918, and at present is taking last year at evening school of engineering at Northeastern College. From 1918 to the present time, with the Division Engineer of the B. & M. R. R., at present as rodman. Refers to S. P. Coffin, P. Jones, J. J. Rourke and W. A. Woods.

MACWILLIAMS, HAROLD FREEMAN, Newburyport, Mass. (Age 19, b. Boston, Mass.) Took a three years' course in the Newburyport High School, then an intensive course at the Huntington School, followed by a year in civil engineering at Northeastern College. Is at present taking a course at Mass. University Extension. During summer vacations worked as rodman and transitman with E. H. Lincoln Co., and the Essex County Engineers; at present with the Department of Public Works, Division of Highways, as inspector on road construction. Refers to A. B. Appleton, A. W. Dean, A. M. Lovis, A. P. Rice and W. N. Wade.

MUESER, WILLIAM HENRY, Boston, Mass. (Age 20, b. Bronx, New York City.) At present, third-year student at Mass. Institute of Technology. During the summer of 1918 worked with the Concrete Steel Engineering Co., New York City, drafting; the summer of 1920 at Mass. Institute of Technology summer surveying camp at East Machias, Me. Refers to J. B. Babcock, 3d, C. B. Breed, J. W. Howard, G. L. Hosmer, H. B. Luther and A. G. Robbins.

SLOAN, JOSEPH WARREN, Charlestown, Mass. (Age 24, b. Dorchester, Mass.) Graduate of Mechanic Arts High School in 1915, a school in France in 1918, and studied civil engineering at Northeastern College 1919-20. Was rodman for J. B. McClintock during the summer of 1914; rodman for Metropolitan Park Commission in 1919, and for the Metropolitan Water Works in 1920; rodman for Division Engineer of the B. & M. R. R. in 1921. Refers to S. P. Coffin, P. Jones, J. J. Rourke and W. A. Woods.

SULLIVAN, THOMAS FRANCIS, Boston, Mass. (Age 43, b. Boston, Mass.) With Boston Elevated Railway Company, from April, 1899, to March, 1905, as timekeeper and clerk; March, 1905, to Oct., 1909, chief clerk; Oct., 1909, to Sept., 1912, assistant superintendent of tracks; Sept., 1912, to April, 1918, roadmaster of surface lines. From April, 1918, to date, commissioner of public works, City of Boston. Refers to E. S. Dorr, C. T. Fernald, H. C. Hartwell, A. T. Sprague, Jr., H. M. Steward and F. O. Whitney.

EMPLOYMENT BUREAU.

THE Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society room two lists are kept on file, one of positions available and the other of men available, giving in each case detailed information in relation thereto.

MEN AVAILABLE.

No. 520. Age 26. Six months' experience installing and inspecting thermostatic heating control devices; a year and a half drafting and compiling cost data for valuation purposes; nearly two years in U. S. Army, Corps of Engineers, on various engineering work; nine months compiling insurance schedule. Salary desired, \$175 per month.

No. 521. Age 24. Five years' experience in structural design and detailing; one year in architectural drawing. Desires position as structural draftsman. Salary desired, \$40 per week.

No. 522. Age 26. Graduate of Worcester Polytechnic Institute. Experience, drafting one year, and two years engineer on dry-dock construction. Desires field engineering work. Salary desired, \$200 per month.

No. 523. Age 27. Graduate Lynn Classical High School, and Dartmouth College, 1915. Experience, transitman with B. & M. R. R., draftsman with N. Y., N. H. & H. R. R., railroad engineer on construction. Salary desired, \$36 per week minimum.

No. 524. Age 25. Graduate Massachusetts Institute of Technology, 1918. Experience, seven months drafting and designing concrete, nine months construction and field engineering. Desires position as construction engineer and salary of \$2 500 a year.

No. 525. Age 39. Graduate Lowell schools, also took a course with American Institute. Experience, seven years as rodman and transitman on construction, seven years as transitman and draftsman on subway construction, two years on Merrimack River survey, two years at Squantum plant as civil engineer. Desires position as inspector or transitman at a salary of \$35 per week.

No. 526. Age 37. High school education, also attended Y. M. C. A. Experience, sixteen years in street railway drafting, laying out and designing special work, one year as assistant engineer laying out track and giving line and grade. Desires position as draftsman or transitman at a salary of \$30 per week.

No. 527. Age 27. Graduate Lehigh University, degree of C.E. Special studies in mechanical and mining engineering. Experience, five years

as assistant to general superintendent of shipbuilding corporation on steel fabrication, etc., eight months steel mill building construction, and fourteen months railroad engineering. Desires position as production superintendent in steel construction work, at a salary of \$2 500 a year.

No. 528. Age 24. Graduate of High School, one year Wentworth Institute (construction course), two and a half courses completed in Mass. University Extension, and two years evening school, Framingham High School. Experience, one year sugar refinery machinery, four months designing piping layouts, one year as assistant engineer. Desires position as assistant engineer in factory or machine shop at a salary of \$175 a month.

No. 529. Age 30. Graduate Worcester Polytechnic Institute. Experience in structural steel erection, oil tank and oil refinery erection, concrete construction, estimator, right-of-way grants, gas plant erection and concrete detailing. Desires position as concrete designer or estimator or resident engineer on concrete construction, at a salary of \$50 per week.

No. 530. Age 25. Graduate Dorchester High School, evening technical school, two years at Wentworth Institute and two years at Franklin Union. Experience, one year structural steel and mechanical conveying equipment, one year mechanical lay-out and oil-burning installation, one year machine detail and structural drafting. Desires position as draftsman at \$30 per week.

No. 531. Age 25. Graduate of Northeastern Engineering School. Experience, three years land surveying, one year railroad work and six months drafting. Desires a salary of \$30 per week.

No. 532. Age 25. Graduate of Tufts College 1917, with degree of C.E. Experience as rodman and level man in mining survey, as inspector and engineer on electric conduit construction, as transitman on concrete and steel buildings, eighteen months with U. S. Engineers (23d) on technical work in France, in surveys, testing materials, inspecting and in charge of street work in a city engineer's office. Desires position as chief of party, resident engineer or assistant engineer, at a salary of \$50 per week.

No. 533. Age 23. Graduate Mechanic Arts High School, 1915. Now attending Lowell Institute, second year, building course. Experience, transitman on railroad, chief of party on development work. Desires position as transitman or inspector at a salary of \$25 per week.

No. 534. Graduate of Mass. Institute of Technology in structural architecture. Experience, eighteen years inside and outside work with consulting engineers, corporations, etc., as designer in office and superintendent in field, outside superintendent of reinforced concrete office and factory, resident engineer on construction of a chemical plant, then plant engineer of same, structural engineer of auto-tire plant and offices. Desires position as a structural engineer for corporations, or for general contractors.

LIST OF MEMBERS.

ADDITIONS.

ARCHIBALD, HENRY C.....	163 Hancock St., Everett, Mass.
CHASE, WILLIAM H.....	216 Middle St., New Bedford, Mass.
CLARK, THEODORE PARKER.....	6 Ridgway St., Winchester, Mass.
KEITH, SCOTT.....	14 Beacon St., Boston, Mass.
KRIGGER, ANSELMO.....	51 Dana St., Cambridge, Mass.
LUCAS, JOHN.....	86 Eastern Ave., East Lynn, Mass.
NEWCOMB, GEORGE H.....	75 Glendale Rd., Quincy 69, Mass.
ROSE, BERNARD S. (with Charles T. Main),	
	201 Devonshire St.; Boston, Mass.
TRAVERS, J. FRANCIS, JR.....	55 Hampden Hall, Cambridge, Mass.

CHANGES OF ADDRESS.

BELLAMY, ROBERT BAYARD . . .	25 Elden St., Grove Hall P. O., Boston, Mass.
BURLEIGH, WILLARD G.....	40 Waverley St., Waverley, Mass.
BROWN, WILLIAM A.....	99 Orient St., East Boston, Mass.
CANNON, MADISON M.....	88 Broad St., Boston, Mass.
CHAPMAN, B. R.....	61 Turner St., Brockton, Mass.
HODGES, ARTHUR W.....	487 So. Main St., Randolph, Mass.
O'BRIEN, JOSEPH H., Care Foundation Co.,	120 Liberty St., New York, N. Y.
RHODES, RALPH F.....	Care U. S. Engrs. Office, Muscle Shoals, Ala.
ROBINSON, ASHLEY Q.....	276 Church St., Newton, Mass.
SMALL, GILBERT.....	Care J. R. Worcester & Co., 79 Milk St., Boston, Mass.
SAWYER, GEORGE A.....	30 No. Franklin St., Wilkes-Barre, Pa.
TOSI, JOSEPH A.....	2 Kingsbury St., Worcester, Mass.
TUCKER, LESTER W.....	Ch. Engr., Henry R. Kent & Co., Rutherford, N. J.
WAITE, EDWARD B.....	Drawer 946, Westboro, Mass.
WEBB, GEORGE F.....	Box 223, Douglasville, Ga.
WOOD, WILLIAM A.....	149 Tremont St., Boston, Mass.

DEATHS.

VAUGHAN, LOUIS B.....	July 23, 1920
SCORGIE, JAMES C.....	February 16, 1921

LIBRARY NOTES.

RECENT ADDITIONS TO THE LIBRARY.

U. S. Government Reports.

Annual Report, Director United States Coast and Geodetic Survey, 1920.

Report of Librarian of Congress, June 30, 1920.

Annual Report on Statistics of Express Companies, 1919.

Interpretative Report of U. S. Council of National Defense, Woman's Committee, April, 1917, to February, 1919.

State Report.

Massachusetts. Annual Report of Highway Commission. 1919.

Massachusetts. Annual Report of Commission on Waterways and Public Lands. 1919.

Massachusetts. Annual Report of Homestead Commission. 1919.

Massachusetts. Industrial Review No. 3, October, 1920.

New York. Annual Report Public Service Commission. 2 vols. 1917.

Wisconsin. Wisconsin Survey. Bulletin No. 57.

Municipal Reports.

Boston, Mass. Annual Report City Planning Board. 1919.

Miscellaneous.

Defend Your Steam. Magnesia Association of America.

Production of Iron and Steel in Canada. 1919.

Quebec Bridge Inquiry, Vol. 2. 1908.

Railway Statistics of United States. Slason Thompson. 1919.

Steel Railway Bridges. Edward C. Dilworth.

White Lead — Its Use in Paint. A. H. Sabin.

LIBRARY COMMITTEE.

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

RAT EXTERMINATION AND PROOFING WITH RELATION TO THE PREVENTION OF PLAGUE.

BY L. L. WILLIAMS,* PAST ASST. SURGEON, U. S. PUBLIC HEALTH SERVICE.

(Presented before the Sanitary Section, January 5, 1921.)

I AM not going to attempt to tell the entire story of plague, because it could not be done in our limited time, and would hardly serve any good purpose. I appreciate that I am speaking to a society of engineers who presumably, from their calling, would be interested in the more technical side of the subject, — rat-proofing; but you would hardly get anything from the discussion unless you knew the reasons which underlie such work. It is hard to understand rat-proofing unless you know something of the habits of rats and of plague. So I will attempt to outline the habits of plague and the habits of rats, in order that you can get the salient points, because in rat-proofing the physician and the plague expert can tell the engineer the object to be attained, and then they are dependent on the engineer to devise the best means of securing that objective. So far, most of the plague work has been done by physicians, and but little by engineers. A great many of the engineering experiments, even, have been carried out by physicians, and as they know but little about engineering principles most of the first work was decidedly experimental.

* State House, Boston, Mass.

Plague is a peculiar disease and develops in waves. There are a few places in the world that have always been infected, or since the earliest known times. These are principally the east and west slopes of the Himalayas, between India and China, Central Arabia and Central Africa. Those are the endemic centers. Plague epidemics are great travelers and in the old days they used to go by caravans. The slow-moving caravan was a community in itself and, as it moved along, carried rats with it. In later days, plague has mostly traveled by ships. I am going to speak of the travel of plague before I speak of its transmission. Plague starts from its endemic centers in a fairly mild form, but as it spreads it becomes more virulent. When the epidemic commences perhaps 3 out of every 10 attacked die. While at its height, as a rule about 8 out of 10 die, showing that it gets stronger as it goes on. That is not only true of each place attacked but is true also as it increases in any given place. In India, for example, it may start with 3 000, 5 000, and 20 000, the next year going to 30 000, then to half a million, and in some cases to a million in a year. In later years the mortality appears to fall off. Plague takes years to spread. Many epidemics have taken as many as twenty-five or thirty years or more. The present plague — pandemic (I call it "pandemic" because it is world-wide) — commenced years ago on the east or west slopes of the Himalaya Mountains; then it reached the port of Hongkong, which was the first port to report a case, in 1894. There was no further plague reported for a few years. Then it spread into Japan, its salient characteristic being that it attacked ports. Very few inland cities got it. Within a few years it was recognized in India, mostly in the ports such as Bombay, Rangoon, etc. Within six years — that is, up to 1900 — a chart of plague would show ports infected in a very large portion of the world. From these points plague spread along shipping routes to the larger coastal cities of China, Japan and India, the east coast, the west coast, the Red Sea and the Mediterranean coast of Africa, and then into the other Mediterranean ports, and about 1899 the east coast of South America, Brazil and Argentina; then on the west coast of South America as far south as Antofagasta and north to Peru; then to San Francisco

in 1900. Quite a stir was made at that time, but unfortunately the seriousness of the trouble was not recognized. Instead of trying to eradicate it an attempt was made to hide it. So it commenced to infect the counties around San Francisco, and California is now an endemic center. Infected animals are there being picked up, and a program for eradicating the disease has been formulated. It is hoped that this will be effected within twenty years. In 1914 the plague had reached New Orleans, and by the summer of 1920, Galveston, Beaumont and Pensacola. The plague has also, at one time and another, infected Liverpool, Glasgow, London, and recently Paris. It is a matter of geographical evidence, by which those who have studied it predict that plague is due to infect one or more of the south or north Atlantic ports within the next decade, and it behooves the Atlantic ports to be prepared for it.

Plague as a disease of man is one thing and as an infection of a port is another. Plague as a disease of man, under present sanitary conditions, is not such a dread disease in civilized communities. In San Francisco the total number never reached as many as 300. In New Orleans there are not yet 100 cases, but in India it still runs in tens and almost hundreds of thousands in a year.

The carrier of plague is the rat flea, by which the disease is carried from rat to rat. There are four or more different types of rat flea. The characteristic that interests us is that the rat flea prefers the rat to any other host. When the plague is pretty prevalent among the rats, and they are dying in large numbers, then the flea gets onto the mice, human beings, and other animals. The rats like our homes and our foods, and many die in or close to houses. Fleas leave a dead rat with amazing speed, and if there are not enough rats or mice to house the fleas they get on to human beings. It has been estimated that plague is a disease of rats in any town at least six months before human beings have it. When plague appeared in New Orleans everybody quarantined against the city, but ships had been coming from New Orleans to other ports for the previous six months without quarantine measures, because no one knew of the presence of plague. That may have been the time other ports

received their infection. Paris has reported about 200 cases of human plague. They have been for some time talking about "Disease No. 9," which we now think is plague. As Paris is not a port and about the only shipping is by barges, which are not transatlantic boats, the question is raised as to how the plague entered Paris. It may be that there is some near-by infected port that is not saying anything about it, yet is plague-infected and sending barges to Paris. Since the war a great many places in Europe are keeping very quiet about their disease situation, and we have no means of knowing how many ships from infected ports are coming into Boston.

In India, animals are more or less worshiped by the natives. In a large part of India their religion teaches that the souls of their ancestors return to the earth in animals. They believe that rats have souls; and in a large part of India they object to rats being killed, and will put out a portion of their food to feed the rat population. That explains the extent of the plague as a disease of man in India. It is not so bad in other parts of the world, unless the bubonic type changes to the pneumonic. In the pneumonic form it attacks the lungs of those infected, with a mortality of about 98 per cent. There is probably a much greater chance of plague, once it becomes an infection of man, taking the pneumonic form in cold climates rather than in the southern climates. It is unfortunate that when plague attacks in northern climates it may change to the pneumonic form, in which case it becomes almost uncontrollable.

When plague attacks a port it is a serious thing, from an economic standpoint. In the first place, there is quarantine. Every civilized port quarantines against the infected place. New Orleans' loss was in excess of \$15 000 000. In the second place, there is a great avoidance of shipping. If Boston was infected and all the ports were quarantined against ships leaving this city, how much easier for a boat to put into New York or Fall River, or some place not infected, and thus escape quarantine! In the first few months of plague in New Orleans the waterfront was almost deserted. After some time, and with preventive and control measures under way, shipping commenced to return, but not as before until the epidemic in New Orleans was well under control.

Then we have the cost of rat extermination which is not a cheap matter. There is probably at least one rat for every human being in the city. In the country there are probably 8 or 10 for every person. If you know the population of Boston you can estimate the population of rats. Plague in Boston would mean, inside of five years, the catching of upwards of 2 or 3 million rats. If it is assumed that the rat-trapper receives about \$100 a month, and above his expenses also receives 10 cents additional for every rat he brings in, some idea of the cost may be obtained.

In addition, rat-proofing is necessary to stop them from finding nesting places. In normal times, when food is fairly abundant and nesting places are easy to find, a female rat will bring forth its young from 8 to 10 times a year, and there are usually from 8 to 12 rats in each litter. Each female commences reproducing at the age of about two months. If there are over two million rats in the city, and in one year's time one million are caught, at the end of the year probably very close to the original population will still remain, provided rat-catching were the only measure instituted. The rat-catcher will probably have done almost no good whatever. It has been noticed that where the food supply is cut off the litters average only from 2 to 4 per year, and the number per litter 2 to 5, instead of 8 to 12. If nesting places are made less available the number of litters falls off, but the number per litter is not affected. The food supply can be handled by proper garbage disposal. This makes it necessary to enforce ordinances for metal-tight garbage cans and rigid rat-proofing of all food-handling establishments. Making it difficult to obtain food and nesting places through rat-proofing of all buildings in the town will do more to eliminate the rat menace than all the rat-trapping that could possibly be done.

As perhaps you know, there is quite a movement on foot to start rat surveys in New England ports, and Massachusetts seems to be taking the lead. There is a reasonable expectation that a substantial appropriation will be made to carry on the work in every port in Massachusetts and Rhode Island. Maine and Connecticut are expected to follow suit. New York City,

Philadelphia, Savannah, Jacksonville and other Atlantic and Gulf ports have commenced work.

Of course the rat survey is to find out if there are any infected rodents and to continue to catch and examine for infection in order to pick up the plague in the rat population before it begins to attack human beings. That means rat extermination and also rat-proofing. Under emergency conditions the cost of those things runs up to three or four times what it would if you are in a position to proceed slowly and systematically. If we find infection among the rats it will very probably be along the water front, and intensive measures only would be necessary for perhaps one or two city squares. Exactly the same measures, but covering the whole city, would be necessary if you wait for a human case. The rat survey will not prevent infection of the rats, but will serve to keep it from human beings. With this comes the necessity for rat-proofing, upon which rests the prevention of spread of plague. If the rat-proofing were 100 per cent efficient in a port, there would be very small chance of plague entering and almost no chance of its becoming an epidemic among human beings. One shining example is Liverpool, where almost all of the water front is of masonry construction, which is rat-proof. The result is that when a case of plague appears to-day on the water front in Liverpool, it does not result in quarantine against Liverpool, as there is small chance of rats invading the city and thus causing an epidemic. Rat-proofing, to prevent nesting facilities and make access to food establishments difficult, is a vital measure in preventing plague.

At New Orleans this has been done, and more recently in Galveston and Beaumont. The houses are divided into food establishments and non-food establishments, each having different regulations. Every food establishment must build a concrete floor at least 4 ins. thick and surrounded with a concrete wall extending at least 2 ft. into the ground and at least 1 ft. above the flood level. It is known in New Orleans that a rat practically never burrows more than 2 ft. underground to make a nest. In many of the houses with masonry foundations and either wood or adobe construction above, it is not unusual at all to set this masonry construction 1 ft. above the ground.

Wherever it is less than 1 ft. often rat holes will be seen above the masonry, where apparently there was no foothold for the rat to climb up. How they make their initial boring, I do not know.

For rat-proofing purposes, rats are divided into two classes, — the Norway and the *alex-rattus*. There are three main types of rats, — *Mus norvegicus*, *Mus alexandrinus*, and *Mus rattus*. The Norway rat — gray, dirty and repulsive — is the largest. As a general rule the rat, including its tail, is not over 12 ins. long, though I have seen them longer. The *alexandrinus* and the *rattus* are very similar but pretty, being built on graceful lines, with long, thin tails. The *alexandrinus* is a blue-gray rat, with white belly and a long tail. The *rattus* is similar in shape but black in color. The thing that groups the *alexandrinus* and the *rattus* together is their common enemy, the Norway. He will not permit any other rat to live in his surroundings, and will even attack cats. In New Orleans we found that sometimes they killed off the cats. As the Norway is a ground rat, their preference is to find a good, solid floor and then bore under the edge of it and back under the floor. That is the reason why rat-proof floors must have chain walls going down 2 ft. into the ground. The Norway rat wants to bore under something that gives good protection above. Apparently he doesn't want rain to come into his nest. The *alex-rattus* is now known as the "roof rat," having been driven off the ground by the Norway. He preferably makes his home between double walls in an attic, or between the ceiling of one room and the floor of the room above. He likes any dark place when he can get to it readily. He wants protection for his nest; wants to get between partitions in a house. The Norway rat in southern climates (I don't know the best methods of rat-proofing in northern climates) is best kept out by means of the concrete chain wall.

Dr. Creel, soon after 1914, when the survey first started, tried to find what would keep rats out. He could get no information on the subject, so he built concrete cylinders of varying strengths of concrete. He took a strong concrete mixture such as is allowable in any building, and had the foreman make a cylinder 3 ins. thick and 2 or 3 ft. across — in which they im-

prisoned Norway rats. In forty-eight hours nothing but a rat hole was left. However, he found that $3\frac{1}{2}$ ins. of concrete, if faced with $\frac{1}{2}$ in. of smooth cement, would stop them, hence the specifications call for 4 ins. of concrete flooring, faced with smooth cement. The wall should be at least 4 ins. thick, of similar construction, to go not less than 2 ft. into the ground, and extend 1 ft. above the floor, and to have no openings. It was not specified how steam or water pipes should go through, because the proper method was not known. That was left to the plumbers and engineers, who had a hard time of it. One man, who put steam pipes through a new foundation to his own home, found that when the steam was admitted the walls cracked, and he was summoned for not having rat-proof construction. I understand that the pipes are allowed to be surrounded with any material which is rat-proof. If holes appear, a change to something else must be made. In most cases pipes are surrounded with soft cement or asphalt. The best method of all is to put a collar of galvanized iron wire around the pipe, held close to the pipe with a band, and spreading out on the wall, and attached thereto in some fashion. It has been found that $\frac{1}{2}$ in. mesh is the largest that can be allowed, and it must be at least 12-gage. Rats have been known to gnaw through lighter construction.

The problem of the home in New Orleans, where they are not addicted to cellars, is a serious one. Most of the houses, which are some 20 ft. apart, were raised 18 ins., — set on underpinning, the rubbish underneath cleaned out and three sides left open. That let in plenty of light, which discourages rats. But that method I do not believe is applicable in northern climates to any very great extent, on account of the effect of low temperature under a house elevated 18 ins. and having three sides open. The frame house in New Orleans, as well as in Boston, is another problem on account of double walls. Usually the owner may do one of two things, — either close the double walls, so that the rats cannot get between them, or tear out one of the walls. The latter was the prevalent method in New Orleans. But in northern climates the double wall makes good insulation for warmth in winter.

If there are cracks in the walls or floor they must be attended to. Rats will get in at the edges and the corners. A rat does not like to gnaw a hole in the middle of the floor. You will find the hole on the edge, where the wall and floor come together, or in corners. There are various methods of protecting against that mode of entrance. In food establishments it is required that these double walls shall be filled in from the floor upwards for a distance of 12 ins., with concrete or other masonry set in mortar, or else a mixture of asphalt tar and cinders, making the lower part of the double wall solid. Under these conditions no rats will gnaw in. The other method is by so-called flashing. The best materials are zinc, galvanized iron, or a good grade of tin. It was found that in all dwellings where there were wooden floors and double walls it was necessary to line the entire floor and wall junction with flashing of a good thick metal rather closely tacked down, to stand up from the floor at least 4 ins. and out from the wall at least 4 ins. That did not always prevent rat holes, but in almost all cases there was a smaller percentage and it was ruled that that would be sufficient. Lately, other methods have been suggested. In New Orleans, as well as in the quarantined towns, concrete and metal have been insisted upon as almost the only rat-proofing materials. Since a sanitary engineer has been connected with the work other methods have been devised which are cheaper than concrete. One is by the use of expanded metal, especially for floors in food establishments. Mr. Allen, whom I have seen recently, says that expanded metal with $\frac{3}{4}$ -in. cup expanded to $\frac{1}{2}$ in., set between thin planking or embedded in thin concrete, is just as good rat-proofing material as the best concrete. He has also stated that galvanized iron wire, even thin galvanized iron wire, or any good grade of wire if dipped in creosote, when placed between planking is just as good rat-proofing as 4 ins. of concrete. Strange to say, since rat-proofing has been going on, those are the only things that have been suggested as efficient to keep out rats. I do not know whether any other means can be devised in Massachusetts. I am afraid that is one of the things that will be up to the sanitary engineers and the architects. If it can be discovered I believe you can do it.

Another point concerns the rat-proofing of docks. Strange to say, although the epidemic in New Orleans broke out in 1914 it was not until 1920 that rat proofing of the docks of New Orleans was undertaken, except in a temporary and limited fashion. Lately larger and larger appropriations are being made for this purpose. In the beginning it was claimed that the only method of rat-proofing docks was to open entirely that part over water. The dock must be of a single thickness, and it must not be closed with sheet-piling at the edge as that will enclose the dock and make a rat harbor. All that part of the dock over land should be of concrete, and the floor should have a chain wall at least 2 ft. deep around the edge of the floor — all of this made for very expensive construction. As you know, docks are, to a great extent, built on made land, and concrete floors on made land must be rather heavily reinforced. It was found that in putting in a chain wall for these docks it was necessary to go beyond the regulation in order to get a suitable foundation, and that cost money. The cheapest construction that could be devised was interlocking concrete piles in lieu of chain wall. They proved perfectly effective and held their position well, and were much cheaper than laying concrete quite a distance below the water level.

In Galveston one other thing has been allowed, which has proved entirely effective. This has the trade name of Uvella. It is apparently an asphalt rock and is laid down 5 ins. thick. No rat was ever known to find his way through it.

Rat-proofing is primarily to drive the rat out of his harboring place. That is essential in the control of the rat population. To drive the rat out you must consider both the Norway and the *alex-rattus* rats. The Norway rat wants to get under the floor, and sheds with concrete floors, or even concrete walks, may serve. For all of these you must thrust a retaining wall 2 ft. down into the ground. In New Orleans most people tore up their walks, leaving the ground bare. For *alex-rattus* you must eliminate all unnecessary waste spaces. Double walls must be filled up or protected at the edges and corners, that the rat cannot gnaw his way in, and all openings in the wall must be protected, either by filling up with some fairly hard material through which the rat cannot gnaw, or by putting metal gratings across it.

In closing I might say to all of you in Massachusetts that if the plague comes into Boston I believe you are going to have a difficult piece of work on your hands.

DISCUSSION.

H. C. MOSMAN.* — I do not know that I can add anything to what Dr. Williams has said. He was ahead of me in New Orleans, and when I got there he had the subject pretty well studied.

I was sent to the Gulf coast states by the State Department of Health, to study rat-catching and rat-proofing. Of course southern is much different from northern construction. Houses and buildings in the South are nearly all set on piles, with a lot of lattice work around the front. In the North there are cellars with walls built up for the house to set on, so that rat-proofing here would be nothing to what it is in the South. Down there I heard a great many people, when told they would have to rat-proof, object to the expense, and there was much adverse comment. But after the work was done they told how they had improved their property and were quite satisfied.

DANA SOMES.† — We have been protected in Boston by the building law pretty well, for a good many years, on rat-proofing, and do not get rats inside our houses very much. I was interested in what Dr. Williams said about rats not going down more than 2 ft.

I have had a personal experience recently with rats in the Charles Street region, where a new sewer is being built. All through there they formerly had no particular trouble from rats; since they have been digging a perfect plague of rats has been in evidence. Where do those rats come from? Do they live in the drains or way down underground, or where do they come from? We see them in the streets where we never saw them before. That seems to argue that Boston is fairly well rat-proofed, that we never see them at other times — that is, in the buildings. I wonder what measures could be taken to get them

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out of the sewers, which are 8 ft. or so below ground. Just how much of a menace is that?

DR. WILLIAMS. — The reason for the 2-ft. drop of the chain walls in New Orleans is on account of the elevation above sea level. Along the Gulf coast the elevations are put on the railroad stations. Such elevation records as 4 ft., 6 ft., $5\frac{1}{2}$ ft. will be seen. New Orleans is about elevation — 3 ft. Galveston is practically at sea level, and by going down 2 ft. water-bearing strata is reached. I suspect that is the reason they do not go deeper than 2 ft. In Beaumont the 2-ft. drop was not entirely effective. This is a region of gumbo, — black, waxy mud, — and rats were found there burrowing as deep as 6 ft. Whether in Boston it would be necessary to go down 2 or 10 or 12 ft. remains to be seen. If some rats will burrow very deep, that does not show that the majority will. The rules have to be made to fit the majority.

The rats will use sewers as passageways; and where sewers are broken, especially sewer connections in houses, they are used as a means for entering houses.

When you see rats with your own eyes on the streets you have a walloping big invasion of rats. The rat is a night-traveling animal. Rats have large bristles sticking out from the nose, and used as feelers. To catch a rat put the trap close to the runway, not in the middle of the floor, as he will go around, not straight across a room. For most of his route he is running so that his bristles touch the wall, as he goes by feel. All rat-catchers put their traps close to where they know the rat is going. They see indications of rats where they don't see rats themselves. For the Norway rat his hole should be seen, and then more or less traveled paths leading to it can be found. Where the hole is in the wall it will be noticed that the edges of the hole are grayed by the oil from the rat's fur. If the hole is clean it is reasonably certain that it isn't used by a Norway rat. In the case of house rats the rafters should be inspected, because wherever a house rat goes under a rafter he must clasp it and swing down, and so on the wall under the edge of the rafter is a crescent-shaped gray mark left by his oil. That is an absolute sign of the *alex-rattus*. We have been in warehouses where it was declared

that a rat had never been seen, yet under every rafter was the little gray mark. We got 15 or 20 rats the next morning.

H. P. EDDY.* — I'd like to ask Dr. Williams if in our northern buildings, provided our basement or cellar is protected and there are no holes that come in above the floor that we can see, if the remainder of the house above is sufficiently protected? There is no apparent way to get in unless they climb the wall on the outside, and I assume he can't climb more than 18 ins. above the ground.

DR. WILLIAMS. — The Norway seldom does, but the *alex-rattus* will. He will climb up the walls or gutter pipes, and if he finds an opening he will go right in, and if you have double walls he will nest there just as long as there is food. To get rid of him, trap him, and close all means of entrance into the double walls to keep him from nesting. That is the only thing that can be done.

The infection of the mice is apparently in the same class as infection of man. It only occurs when the epidemic is so great among rats that the rats have died off, so that there are not enough hosts for the fleas; then they get on the mice and infect them at about the same time they get on man. In New Orleans it was noticed where they were examining about 3 000 rats in the laboratory a day, that as the curve of infection of the rats went up it was not until it was half way to the peak that infection of mice commenced, and when the curve came down to about the half-way point the infection of mice ceased. Also, all infected mice that have been caught have been in buildings that have either before or subsequently shown infected plague rats. Infected mice have never been found without a very heavy epidemic among the rats, and as the epidemic subsided among the rats it disappeared in the mice entirely. The flea attacks other animals besides the mice.

In San Francisco it got among the ground squirrels, and about eight counties have been infected, squirrels dying of the infection. It also has been known to attack the raccoon, possum, guinea-pigs and some other animals. I don't believe cats or dogs are ever attacked. The mongoose has been infected in

* Of Metcalf & Eddy, 14 Beacon Street, Boston, Mass.

India, and some other small animals. I don't believe larger animals have been affected. In making the curative serum the horse is used, and given a large shot of infection which makes him sick for a day or so, but he practically always recovers.

One of the rat fleas is a dog flea, — *Canis*, and it apparently carries plague. About four types of fleas commonly infested the rats at New Orleans, and all, so far as we know, carried plague. They were found pretty commonly on all the rats, and some of those fleas were found also on dogs and possums.

All rats are not overrun with fleas, however. The average number of fleas per rat in New Orleans, at the height, was only 2 fleas to the rat, and when I left, $1\frac{1}{2}$ fleas per rat. Somebody asked if fleas got into the laboratory, and if a man then ran any danger of infection. Whereas those rats outside seldom yielded more than 2 fleas to the rat, a rat loose in the laboratory for a week or more seldom yielded less than 60 to 80 fleas.

For examination it is necessary to get a live rat. A tray and a saucer of water (about 3 ft. in diameter) is prepared and the rat hit on the head and then put on the tray. Usually it is not over 30 seconds before the fleas jump out and are drowned.

The plague is often fatal to the rat, but unfortunately a lot get over it, and apparently some remain infected for years. Probably it is migration of rats suffering from chronic plague that carries the disease. Any one that kills and examines a rat with acute plague can readily see whether it was going to recover or die very quickly.

Besides the prevention of plague there are added reasons for rat-proofing. It has been estimated it costs about \$1.87 a year to feed each rat in the United States. This is the minimum value for the minimum amount of food that will support a rat for 365 days. It is reasonable to suppose he gets away with \$1.87 worth of food. In a grain bin he destroys perhaps ten times as much food as he eats. It has been estimated that rats are costing the United States \$500 000 000 a year, and that is a conservative estimate. Any one who is handling foodstuffs — grain or hides — knows this. Rats are mighty fond of hides, and will do a lot of damage. It is worth while as a business move for any one who has perishable material to exterminate

them. I believe in a few years the lessened depredation of rats would repay him.

The matter of stored vegetables in the cellar has been mentioned.

I know that is a problem, and I don't believe economically you can entirely keep them from rats. I don't care how closely you rat-proof a building you can't entirely eradicate them. Some are going to come in every now and then. Take the rat-proofing in stables, for instance; it is required to keep grain in bins lined with metal and kept locked all the time. That is the only thing that keeps rats out of feed bins in the stables. If you want to be sure to keep vegetables away from rats, keep them in a bin. It is, of course, useless to suspend it from the ceiling. I'll guarantee an *alex-rattus* will crawl across the ceiling and come down the sustaining rope. I've seen garlic hung from strings from the ceiling and yet were gnawed by rats; frequently you will see where the rats have been feeding on bananas hung from the ceiling.

Disks, if they stand at least 12 ins. in every direction and fit closely on the rope, will prevent the passage of rats. When these are applied to mooring hawsers they are not always effective because they are often placed up the rope only as far as a man can reach, and the rat can jump as far as that.

The use of poison has been mentioned. In New Orleans barium carbonate is used, mixed with any substance that will make a paste, and spread on bread. It is necessary to replace it every afternoon with fresh bait, and in every case it is placed in sewers or well-guarded places. The indiscriminate use of poison is strongly opposed. It was desired of course to examine all the rats, and if they had been poisoned they would have crawled off and died where they could not be found.

MEMOIR OF DECEASED MEMBER.

WILLIAM M. BROWN.*

WILLIAM MAXWELL BROWN was born in Warwick, R. I., on August 13, 1854, the son of William M. and Susan Allen (Clapp) Brown.

In June, 1885, he was married to Julia Ida Daniels, of Bangor, Me.; he had no children.

He died in Newark, N. J., May 29, 1920.

The following is an outline of his notable engineering career. He prepared for college at the Riverpoint, R. I., High School and entered Brown University in 1870, graduating in 1873 with the degree of Ph.B. In July of the same year he became a student in the Engineering Department of the Providence, R. I., Water Works. In 1874-76, he was assistant engineer in the office of the city engineer, Providence, R. I.; 1876-77, resident engineer on extension of water works, Brookline, Mass.; 1878-84, assistant to H. A. Carson on day-work construction on the Boston Main Drainage Works; 1884-86, assistant engineer of the Massachusetts Drainage Commission, of which E. C. Clarke was chief engineer. In 1886-87, Mr. Brown was chief engineer of the water works of Westerly, R. I.; 1887-89, assistant engineer of the Massachusetts State Board of Health on investigations for sewerage of the Mystic and Charles River valleys.

In 1889, the Commonwealth of Massachusetts appointed a commission for the construction of the Metropolitan Sewerage System for Boston and its numerous adjacent cities and towns. Mr. Carson, chief engineer of this commission, called Mr. Brown as assistant engineer of construction. This work brought out the executive and professional abilities of Mr. Brown, who soon was placed in general charge of the various sewer contract sections, except the main outlet and those in close connection with the estuaries and river siphons. Upon the resignation of the chief engineer, in 1895, Mr. Brown was appointed superintendent of maintenance and chief engineer of construction of the system. Soon the growing needs of the district called for the extension of

* Memoir prepared by Howard A. Carson, Frederick D. Smith and Henry T. Stiff.

the system into the Neponset valley. Mr. Brown recommended the construction of a trunk sewer for the valley, and during the years 1897 and 1898 its construction was carried to a successful conclusion.

In 1899, Mr. Brown reported upon the project of a high-level sewer to intercept the higher areas of Metropolitan Boston south of the Charles River. This project had been previously suggested as a relief measure by the engineers of the city of Boston, with disposal works on Moon Island. Mr. Brown's studies convinced him that the point of disposal into the harbor at Moon Island would soon prove inadequate for the growing needs of the South Metropolitan District. He, therefore, recommended that the sewage be discharged into the strong tidal currents of Boston Harbor, off Nut Island in Quincy. As advised in this report, the legislature authorized the construction of the high-level sewer. This work was designed on more liberal lines than had been any of the previous sewers in the vicinity, a departure that has been fully justified by the development of the district.

The Metropolitan Water Board and the Board of Metropolitan Sewerage Commissioners were consolidated in 1901, and Mr. Brown was retained as chief engineer of sewerage works under the newly formed Metropolitan Water and Sewerage Board, which position he held until he resigned in February, 1912.

As early as 1901, Mr. Brown became interested in the study of a trunk sewer for the cities and towns of the Passaic valley in New Jersey. At that time he was associated with Messrs. Rudolph Hering and J. J. R. Croes, of New York, in reviewing results of former engineering studies for this work. On December 2, 1901, the consulting engineers recommended in their report "that a union of all the communities which contribute to the pollution of the Passaic valley is desirable; that a trunk sewer system from Paterson to the southerly boundary of Newark be constructed; and that provision be made for the joint disposal of the polluted waters in New York Bay near Robbins Reef." Other studies were made during the years 1902 to 1907, with which Mr. Brown had occasional connection. In the latter year the Passaic Valley Sewerage Commissioners were appointed, and

further studies in detail were made under their instructions by Rudolph Hering and George W. Fuller. The whole project was then referred by the commissioners to William M. Brown, Allen Hazen and Edlow W. Harrison, for a final review. These engineers, who were to report individually, concurred in the opinion that the design as submitted contemplating the disposal of sewerage into New York Bay was the most efficient and economical method for the purification of the Passaic River. Mr. Brown's report is dated January 27, 1908. During the years 1909 to 1911, inclusive, detailed surveys and extensive engineering investigations were made, and detailed drawings were prepared, under the direction of Edlow W. Harrison as chief engineer, all in preparation for construction.

This project was similar in many respects to the Metropolitan Sewerage System of Boston, with the construction of which Mr. Brown had been so intimately connected. When in 1912 the Passaic Valley Sewerage Commissioners were ready to begin the building of their great undertaking it was natural and most fitting that Mr. Brown should be called to carry out the construction work. On February 21, 1912, he resigned his position with the Metropolitan Water and Sewerage Board of Massachusetts to accept the position of chief engineer of the Passaic Valley Sewerage Commissioners. The Metropolitan Water and Sewerage Board thereupon passed a vote of recognition of its indebtedness to Mr. Brown, a part of which vote reads as follows:

"His service of more than sixteen years in charge of the building and operation of these systems has displayed a large constructive ability and an intimate knowledge of the details of maintenance. Faithful devotion and prompt execution and accomplishment have characterized the performance of all his duties."

There is evidence that prior to 1890 Mr. Brown did engineering work — not mentioned in the foregoing outline — on mill construction in Lawrence, Mass.; on the Orange, N. J., Sewerage System; on water works in Wellington, Kans., and in Corning, N. Y.

Mr. Brown was elected a member of the American Society of Civil Engineers in 1896, and in 1893 of the Boston Society of Civil Engineers, and a director of the latter society in the years 1901 and 1902. He was a member of the school board of Chelsea, Mass., from 1899 to 1903, and a member of the Boston Chamber of Commerce in 1910.

Mr. Brown had at the time of his death nearly completed the Passaic Valley Sewerage System. His great works will stand as enduring monuments of his ability. His integrity was beyond dispute; his insistence on good work assured lasting construction. Strong in his determination that the municipality should get the class of work it specified, yet with a judicial weighing of the rights of both contracting parties, Mr. Brown obtained results which reflect his genius and energy.

His consideration for the welfare of his assistants promoted a most friendly spirit. The kindly advice given to others when asked for won for him a host of grateful fellow-engineers. It can be truly said that he left the world greatly indebted to him; and his name will long remain in the memory of many admiring engineers and associates.

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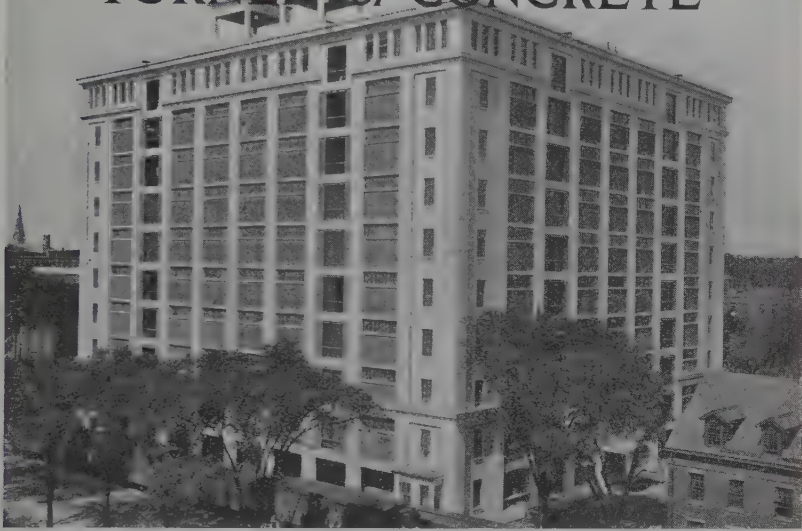
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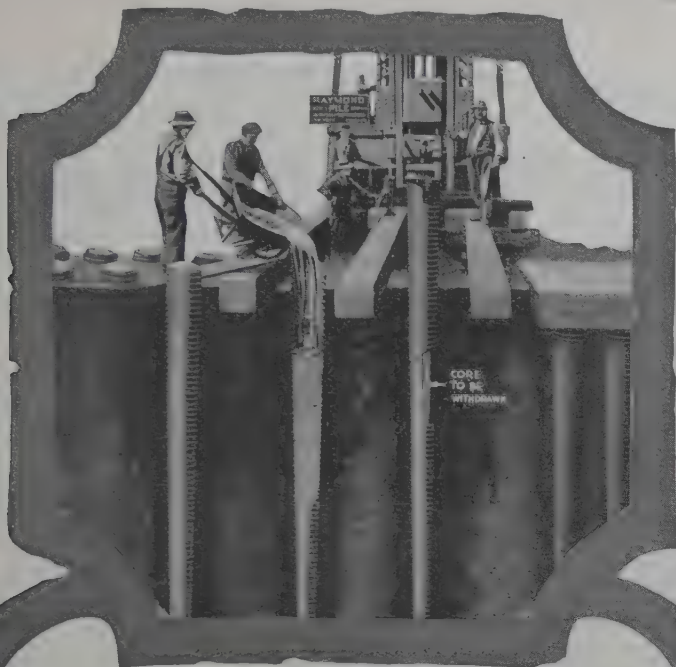
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